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ABSTRACT

Milwaukee Area Technical College's (MATC's) responses to the need for developmental mathematics instruction are reviewed in this paper. The paper begins by briefly describing a project which MATC undertook in 1965 through 1970 to develop technical mathematics materials and courses which were relevant for technicians and matched the entry-level skills and learning speed of the students. It goes on to describe the development of MATC's Crossover Program, which provides basic skills courses to prepare students for entry into technical career programs. After describing the courses and placement procedures used in the General, Health, and Technical Crossover Programs, the paper presents a report on the materials, methods, and results of one section of arithmetic, taught during the summer of 1980. This report describes the MATC-developed module series, the use of diagnostic pretests, the instructional format, and student attrition. It then analyzes student performance, presenting test items which were answered correctly by 100% of the students completing the math course and items which were performed correctly by less than 67% of the students. Each subject area on the final exam is then examined in terms of the number of students performing items correctly. Finally, the report presents a discussion of students' negative attitudes towards mathematics, including samples of student comments about their feelings toward math. (KL)

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THE DEVELOPMENTAL MATHEMATICS CURRICULUM AT MILWAUKEE AREA TECHNICAL COLLEGE: AN HISTORICAL PERSPECTIVE

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THE DEVELOPMENTAL MATHEMATICS CURRICULUM AT MILWAUKEE AREA TECHNICAL COLLEGE: AN HISTORICAL PERSPECTIVE

Introduction

Changes in high school curricular requirements, broader admission policies, and "non-traditional" students have all worked to create a real need for the discussion of remedial-developmental mathematics in higher education.

The Milwaukee Area Technical College was established in 1912 with the philosophy that "the needs of the student shall determine the curriculum." It has evolved into a comprehensive community college with over 12,000 full-time equivalency students. "Elitism" has never been associated with MATC's mission and therefore the administration and faculty readily adjusted to the needs of students that other institutions label non-traditional.

The first arithmetic course for high school dropouts was offered in 1912, mathematics "refresher courses" have been offered for over fifty years, and developmental mathematics courses for Junior College students have been offered since the mid 1960s.

The Carnegie Project

In 1965 The Carnegie Corporation awarded a grant to the Milwaukee Area Technical College for a curriculum development project in technical mathematics. The project was conducted from 1965 to 1970 with the goals of increasing learning and reducing student dropouts in technical mathematics. The criteria for course development for the project were as follows:

1. Each topic had to be relevant for technicians.
2. The content had to begin at a level which coincided with the entry skills of the students.
3. The instruction had to proceed at a pace which coincided with the learning speed of the students.

In order to satisfy these criteria, the project staff developed technical mathematics materials that contained a developmental component.

The Crossover Program

By 1970 it was clear that many students entering community colleges were not mathematically prepared for technical education. There were students who needed more developmental education than was possible within a component of an existing course. The Milwaukee Area Technical College responded to these needs by initiating the Crossover Program. This program provided courses in the basic skills areas to prepare students for entry into technical career programs.

The program now offers courses in Reading, Communication Skills, Psychology of Human Relations, Quantitative Science Skills, and Mathematics. These courses are offered to the students in one of three programs: Crossover-General, Crossover-Health, Crossover-Technical.

The Crossover Curriculum

Entering crossover students are given evaluation tests in reading, mathematics, and writing. They are then assigned to courses that match their basic academic skills. These academic needs, combined with career goals, are used to place the student in the appropriate crossover program. The following curriculum is used:

I - CROSSOVER-GENERAL (Placement is determined by student's career goals.)

1a. Communication Skills)
b. Basic Writing Skills) Placement is determined by academic needs.

2a. Reading and Study Techniques 1) Placement is determined by
b. Reading and Study Techniques 2) academic needs.

3a. Arithmetic)
b. Algebra) Placement is determined by academic needs.

4. One social science course (usually Phychology of Human Relations).

5. Orientation.

II - CROSSOVER-HEALTH (Placement is determined by student's career goals.)

1a. Communication Skills)
b. Algebra) Placement is determined by academic needs.

2. Reading and Study Techniques 2.

3. Biological Science Survey.

4. Basic Chemistry.

5. Orientation.

III - CROSSOVER-TECHNICAL (Placement is determined by student's career goals.)

FIRST SEMESTER

1. Communication Skills 1.

2. Reading and Study Techniques.

3. Basic Physics 1.

4a. Algebra) Placement is determined by academic
b. Technical Mathematics) needs.

5. Orientation.

SECOND SEMESTER

1. Communication Skills 2.

2. Basic Physics 2.

3a. Calculation and Calculators) Placement is determined by
b. Technical Mathematics 2) academic needs.

4. One social science course (usually Psychology of Human Relations).

Classroom Organization and Student Performance in Arithmetic

This report describes the materials, methods, and results of one section of Arithmetic during the summer of 1980.

The Arithmetic Module Series by McHale and Witzke are the required texts for Math 190. These texts were developed at MATC specifically for MATC students. The "series" is a complete system of instruction involving instructional texts, pre-tests, assignment tests, unit tests, multi-unit tests, comprehensive tests for each module, comprehensive tests for the entire five-module series.

For the summer of 1980, only the unit tests and comprehensive tests were used. This fit nicely into the time structure of the summer course.

A diagnostic pre-test was given to determine at what level the instruction should begin. It was found that the students were fairly well prepared in the area of basic whole numbers. This allowed the instructor to omit the whole number book and present a review of whole numbers as a series of lecture/discussion sessions.

Following the whole numbers presentation, the class proceeded with a standard format. Each new topic was presented by the instructor. The students were then assigned extensive homework. Some of the homework was supervised by the instructor, the majority was done outside of class. The next class meeting involved a review and discussion of the assignment followed by a unit test to evaluate the students' mastery of the material. The entire process was then repeated for the next topic.

TABLE 1
UTILIZATION OF CLASS TIME
MATH 190 - SUMMER, 1980
7:55-10:35 a.m.
(160 Minutes)

Activity	Time
I. Review/discussion Assignment X	20-40 minutes
II. Unit Tests for Assignment X Administer/Evaluate/Tutor	45-80 minutes
Break	10 minutes
III. LECTURE ASSIGNMENT Y	20-40 minutes
IV. Individual Instruction/Tutoring	10-30 minutes

NOTE: All students attend the full 160-minute class period.

The following table shows student attrition at different points during the course.

TABLE 11
STUDENT ATTRITION

	Number of Students	Reason for Attrition
Total number enrolled and attending at the end of week #1	23	
Total number completing Whole Numbers	23	
Total number completing Fractions	21	1. One drop for psychological reasons. 2. One drop for academic reasons.
Total number completing Decimals	20	1. One moved to South Carolina.
Total number completing Ratios and Percents	20	
Total number completing Rounding and Estimation	19	1. One drop for personal reasons.

Analysis of Student Performance

The following test items were performed correctly by 100% of the students completing the Math Workshop during the summer of 1980.

1. In 438,259 what digit lies in the "hundreds" place?

2. Write "nine thousand, eighty-two" as an ordinary number.

5. 1500 - 83

6. 2085
   ×8

8. 524
   ×301

9. 5 / 535

11. 260 / 11,700

13. To pay for a TV set, a family agreed to pay $23 each month for 30 months. Find the total amount to be paid.

14. Complete: $\frac{7}{8} = \frac{}{24}$

15. Reduce to lowest terms: 24/36

16. Convert $\frac{17}{3}$ to a mixed number.

17. Convert $4\frac{2}{5}$ to an improper fraction.

32. Write $\frac{27}{100}$ as a decimal number.

44. If 10 sheets of plywood cost $126.50, find the cost of one sheet.

46. Convert to a whole number or a fraction in lowest terms. 200%

49. Convert to a percent .43

67. $6^2 =$

The following test items were performed correctly by less than 67% of the students completing the Math Workshop during the summer of 1980.

Test Item	% Correct
40. $2.3 \overline{)188}$	39%
50. Convert to a percent: .005	50%
52. Convert to a percent: $\frac{120}{400}$	56%
54. 15 is what percent of 30%	56%
63. Round this calculator quotient to thousandths $74 \overline{)397.42}$ 5.370540541	56%
66. Estimate this quotient (to one non-zero digit)	56%
74. Find P if V = 45 and N = 5 $P = \frac{V}{N}$	56%
77. Write in scientific notation 46.8	50%

Self-paced instruction has become popular in developmental programs over the last ten years. Some disadvantages to self-paced instruction are the lack of opportunity for group instruction and, in some cases, appropriate peer interaction.

MATC
MATH WORKSHOP
ITEM ANALYSIS (JULY, 1980)

FINAL EXAM
Mean = 84.2%
N = 19

PERCENT OF STUDENTS WORKING EACH ITEM CORRECTLY

Topic	Item No.	Correct	Incorrect
Whole Numbers	1.	100%	0%
	2.	100%	0%
	3.	94%	6%
	4.	89%	11%
	5.	100%	0%
	6.	100%	0%
	7.	89%	11%
	8.	100%	0%
	9.	100%	0%
	10.	94%	6%
	11.	100%	0%
	12.	89%	11%
	13.	100%	0%
Fractions	14.	100%	0%
	15.	100%	0%
	16.	100%	0%
	17.	100%	0%
	18.	94%	6%
	19.	94%	6%
	20.	89%	11%
	21.	78%	22%
	22.	78%	22%
	23.	67%	33%
	24.	67%	33%
	25.	72%	28%
	26.	94%	6%
	27.	94%	6%
	28.	83%	17%
	29.	78%	22%
Decimal Numbers	30.	94%	6%
	31.	83%	17%
	32.	100%	0%
	33.	89%	11%
	34.	83%	17%
	35.	100%	0%
	36.	94%	6%
	37.	89%	11%
	38.	72%	28%
	39.	83%	17%
	40.	39%	61%
	41.	94%	6%
	42.	78%	22%
	43.	89%	11%
	44.	100%	0%
Percent Ratio and Proportion	45.	94%	6%
	46.	100%	0%
	47.	89%	11%
	48.	72%	28%
	49.	100%	0%
	50.	50%	50%
	51.	78%	22%
	53.	94%	6%
	54.	56%	44%
	55.	83%	17%
	56.	83%	17%
	57.	83%	17%
	58.	83%	17%
	59.	83%	17%
	60.	67%	33%
Rounding Estimation, Squares, Square Roots Formula Evaluation, and Scientific Notation.	61.	72%	28%
	62.	78%	22%
	63.	56%	44%
	64.	67%	33%
	65.	83%	17%
	66.	56%	44%
	67.	100%	0%
	68.	78%	22%
	69.	100%	0%
	70.	83%	17%
	71.	67%	33%
	72.	78%	22%
	73.	78%	22%
	74.	56%	44%
	75.	67%	33%
	76.	78%	22%
	77.	50%	50%
	78.	83%	17%

The summer program at MATC had unique time constraints. This demanded that the instructor implement classroom activities that enabled the developmental student to complete a semester's work in six weeks. Past experience has shown that self-paced instruction has not always worked well under these time constraints.

The procedures outlined in this paper were successful in that an unusually high percentage of students achieved the objectives of the course.

Attitudes of Students Toward Mathematics

One of the objectives of the beginning algebra course at MATC is to reduce mathematics "anxiety." Part of the process of dealing with this anxiety involves determining the students' attitudes toward mathematics. During the spring semester of 1981, nineteen students enrolled in one section of beginning algebra were asked to respond to the following question:

"Is your attitude toward mathematics positive, negative, or neutral?"

"If it is positive, write one specific event that contributed to that positive attitude."

"If it is negative, write one specific event that contributed to that negative attitude."

"If it is neutral, write one specific positive event and one specific negative event."

Twelve students responded negative, four neutral, and three positive. An unedited sample of the negative responses are listed below.

1. "It began when I was in the 5th grade. I had a teacher who I was very much afraid of. She made me afraid to ask questions about how to work out a problem or how to arrive at a certain answer. Instead of her going over the assignment, she would say, 'Work it out and it better not be wrong.' And for me (and others) my assignment would be wrong. She then would take a ruler or yard stick and hit me on the palm of my hand or hit me on the rear. And even after the hitting, I still got the problem wrong. She hardly ever explain anything to the class. She said, 'You just got of the 4th grade you should know what you're doing'."

2. "I 5th grade before class was left out for lunch we had to give the correct answer to a multiplication problem, then In 10th grade algebra I had to get used to 3 different teachers in 1 year.

Algebra 191 Jan to May 1980 Mr. ..... made me nervous and tense with his attitude about not everybody being able to be a college graduate and that his 4th hour class was worse than his other class's."

3. "I feel that my hang ups about Math comes from grade school, I didn't like it then, I never had a chance to get seriously involved, so I have always had a big doubt in my mind about Math. Wether I could respond the proper way. That in itself made me dislike it a lot. Also hearing every one say just how hard Math is, made me have a negative attitude."

4. "My attitude toward math has been negative always. I feel this is because I'm a slow person and shy at times. The teacher I had in 4th grade made the children stand up at there seat or in front of the class and say there time table I could not say the answer for 8 x 7 fast enough."

5. "I gain this attitude when I was in the 5th grade. We had a math test with another class where two students had to go to the blackboard and do a problem. I didn't know how to work my's so my teacher call me dum in front of all the other kids. I felt really bad and ecery sense than all math teachers I have had didn't care or take out the time to help slow kid or kids who needed extra help even in high school I needed help and my teacher would say well go home and study this unit and you should be able to work it. But I wasn't and we usually went on to something else."

6. "I never cared much for math I see a problem and have no confidence that I could be able to work it out. I think I suffer from math anxiety. I have had these feelings since 9th grade."

7. "I'm really not numerically good. It's been that way since elementary school. So I guess I 'Hate' it. Sometimes I get good grades, I passed last year with a hi C, but I just really can't get it to stick in my mind. I guess the basic concepts are my down fall. Algebra scares the hell out of me because I don't see how you can take a letter and make a number out of it and vice versa."

As illustrated by the above comments, we as college mathematics teachers are charged with developing students' skills which have been in disuse since the fourth or fifth grade. We are also required to overcome the students' negative attitudes towards mathematics and mathematics teachers so that these skills can be developed.

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